A.2. Global property space

In the ranking task of Experiment 1, there was considerable spread in the ranking values for each of the basic-level categories (waterfall, river, ocean, mountain, lake, forest, field and desert) along each global property (see Table 1). Fig. A1 shows every image's rank for each global property, broken down by basic-level category (see Section 3.1).

Fig. A1. The figure shows the mean rank of each of the 200 scene image, in their respective semantic category, along each of the seven global properties. These are from the ranking data from Experiment 1. In all basic-level categories, there is a considerable spread of image rankings, indicating that the eight basic-level categories used in Experiments 1, 2, 3 and 4 do not cluster along single global properties. Abbreviations of the basic-level categories correspond to: waterfall, river, ocean, mountain, lake, forest, field and desert.

Table A2 shows the correlations between the images' ranking along one global property to the images' ranking along each other global property, from Experiment 1. Correlations between image rankings were computed for each pair of global properties in the database.

It is of note that these correlations are more a reflection of the landscape images in the natural image database we used, and less a statement about the similarity of the property concepts. For example, in this database *openness* and *mean depth* are highly correlated. However, previous work has shown that for a larger and more diverse database of real-world scenes, this relation is much less strong (Oliva & Torralba, 2002).

While the global properties are not all statistically independent with each other (Table A2), each property gives unique information about the scene images. For example, while all *open* places also have large *mean depth*, not all large depth pictures are necessarily open (see Fig. A2A). Likewise, places that are easily *navigable* might or might not be have *perspective* (see Fig. A2B), and two very closed places such as forests can have different degree of expansion (see Fig. A2C). It is of note that *concealment* and *navigability* are not correlated with one another (r = 0.13). This is because it is the size and distribution of the obstacles in a scene that matter for estimating these properties in a given space, and not merely the presence of obstacles. For example, a very dense forest of thin trees does not provide good cover for a human (low navigability and low concealment), and a forest with a clear path through it would rank highly for both navigability and concealment.

Fig. A2. (a) A scatterplot of the rankings of the 200 natural scenes along *mean depth* and *openness* (from Experiment 1) shows that although there is a strong correlation between these properties in this particular database, these properties represent distinct spatial concepts. For example, images with *large depth*, can either be very *open*, with an infinite horizon like the picture of the canyon, or moderately *closed* such as the mountainous landscape scene, where the horizon is bounded by a peak. (b) A scatterplot showing all image ranks along the *navigability* and *expansion* dimensions. The two images shown are perceived as having a *high degree of navigability*, however they have a different linear perspective. (c) A scatterplot between *openness* and *expansion* dimensions, illustrated the fact that *open* environments may have different degree of perspective. Each dot in the scatterplot represents the mean rank of one image, averaged over at least 10 observers.

To further test the structure and dimensionality of the ranking data of Experiment 1, we employed classical multi-dimensional scaling (MDS) from the Euclidean distance matrix of images along the seven global properties. The first three dimensions of the solution are plotted in Fig. A3a. The eigenvalues of the y^*y' transformation matrix are plotted in Fig. A3b. Unfortunately, there is no objective test of MDS dimensionality. A “scree” or elbow test is typically employed to test the underlying dimensionality of an MDS solution. The lack of an obvious elbow as shown in Fig. A3b suggests that all seven dimensions, although correlated, contribute to the scene category representation.

Fig. A3. The classical multi-dimensional scaling (MDS) solution for the global property rankings from Experiment 1. (a) A scatter plot of each of the 200 scenes in the database projected onto the first three MDS dimensions. Different semantic categories are shown in different colors. (b) Scree test showing eigenvalues for the y^*y' matrix of the MDS: there is no obvious elbow in these values indicating that all global properties have a unique (if unequal) contribution to the scene representation.

What are the MDS dimensions representing? Table A3 shows that significant correlations exist between all MDS dimensions and all global properties. The MDS dimensions show interesting combinations of global properties: for instance, dimension 1 is mainly representing the structural global properties, and dimension 5 opposes *concealment* and *navigability*.